

P.001

Hemopericardium on postmortem CT: What does "hyperdense armored heart" indicate?

M. Murakami, A. Akashi, U. Uetani, M. Murase, Y. Yamamoto, I. Ikematsu
Nagasaki University Graduate School of Biomedical Sciences, Nagasaki, Japan

Objective: Hyperdense armored heart (HAH) is known as postmortem evidence of the heart beating for a time after the initiation of intrapericardial bleeding, which has been previously reported as a double-concentric stratification of intrapericardial blood with the densest ring on the epicardial surface in acute aortic dissection (AD). The objective of this study was to clarify the frequency and etiology of HAH on PMCT.

Materials and Methods: Between January 2012 and December 2015, 1290 subjects underwent PMCT at our institute. Of these, 31 subjects with hemopericardium on PMCT were enrolled in this study. Based on the presence or absence of HAH on PMCT, we categorized subjects into two groups (subjects with HAH and without HAH), and the causes of hemopericardium presumed by PMCT were compared between the two groups.

Results: Hemopericardium on PMCT showed HAH in 23 of 31 subjects. In the remaining 8 subjects, a fluid-fluid level (hypostasis) was seen in 4 subjects and no such feature in 4 subjects. HAH was seen in subjects with AD in 12 of 14 subjects, cardiac rupture in acute myocardial infarction in 7 of 9, and other causes in 4 of 8. AD was the most frequent cause of hemopericardium in subjects with HAH (12 of 23 subjects). However, the frequency was not statistically different from that in subjects without HAH (2 of 8 subjects) ($P > 0.05$).

Conclusion:

Although hemopericardium with HAH on PMCT is most frequently seen in subjects with AD, HAH can be associated with various pathological processes.

P.002

Prosthetic imaging in forensic radiology

B. Temme
University of Nebraska Medical Center, Omaha, United States of America

The use of radiography to help identify deceased individuals or human remains is a landmark contribution to forensic science. For many years forensic pathologists have used radiography to acquire a permanent record of part of a deceased person's anatomy and pathology before performing an autopsy. Radiographic images are a representation of the patient's anatomic structures and serve various purposes. Comparison of ante mortem and postmortem images may be useful. However, if ante mortem information is not available, postmortem images alone may provide critical information. The purpose of this exhibit/presentation is to demonstrate the importance of acquiring radiographic images of various prosthetic devices for postmortem identification.

P.004

Drowning lung CT patterns; experimental evaluation

H. Hyodoh¹, R.T. Terashima², M.R. Rokukawa¹, J.S. Shimizu¹, S.O. Okazaki¹, K.M. Mizuo¹, S.W. Watanabe¹
¹Sapporo Medical University, Sapporo, Japan, ²Japan Coast Guard, Otaru, Japan

Purpose: Experimental drowning models were prepared to investigate the time-related course of lung changes using postmortem CT. This study was approved by our institutional animal ethics committee.

Materials and Methods: Fifteen NZW rabbits (female fifteen, 2.6 - 4.3 (mean 3.3) kg) were divided into 3 groups: fresh water drowning (FRESH), sea water drowning (SEA), and sea water drowning with anterior chest compression (ACC). All individuals were examined by CT (Aquilion CX, Toshiba, Japan) on postmortem time course. The rabbit's head was submerged in a water bath for a total of 10 minutes. In ACC, cardiopulmonary resuscitation was performed for 2 minutes, additionally. The percentage of aerated lung volumes (%ALV = 100 (aerated lung volume / total lung volume) were statistically evaluated and the lung CT image patterns and pleural fluid appearance time were investigated.

Results: All lungs had decreased their %ALV within 24 h, and there were no statistical differences in and among the 3 groups. After 36 h, %ALV tended to increase in all groups, and only ACC presented a statistical difference between 1h and 36 h ($p < 0.005$).

On postmortem lung CT, all lungs presented ground-glass opacity with interstitial thickening spread pattern (100%) and no pattern change during the follow-up period. After presenting pleural space fluid collection, the %ALV tended to increase.

Conclusion: There were no differences among FRESH, SEA, and ACC in %ALV within 24 h. Only ground-glass opacity could be detected on postmortem lung CT, experimentally.

P.005

Can perinatal post-mortem MRI reporting be learnt? Diagnostic accuracy of 200 cases

O.J. Arthurs¹, J.C. Hutchinson¹, C. Ashwin¹, X. Kang², J. Jani², N.J. Sebire¹
¹Great Ormond Street Hospital, London, United Kingdom, ²CHU Brugmann UVC, Brussels, Belgium

Objectives: To assess whether a single trained practitioner can achieve acceptable perinatal post mortem magnetic resonance imaging (PMMR) reporting diagnostic accuracy, compared to conventional autopsy and published standards.

Methods: We compared pre-autopsy PMMR to conventional autopsy for the detection of: (a) major pathological abnormalities related to the cause of death; and (b) all diagnostic findings in five different body organ systems.

PMMR was reported blinded to autopsy findings.

Results: 123 / 146 major abnormalities were identified by PMMR in 201 cases. Overall diagnostic accuracy of PMMR was 89.6% (95% CI 84.3, 93.2%) across all cases, with high concordance 91.8% (95% CI 89.9, 93.4%) across most organ systems. Single reporter statistics were similar to those previously reported, and better for neurological and thoracic systems, as well as overall (91.8 vs 87.1%; diff 4.7% (95% CI 2.1, 7.3%) $p < 0.01$).

Conclusion: PMMR examinations can be accurately reported by a single radiologist, following a period of experience and training with this specific modality, with high diagnostic accuracy for all organ systems.

P.006

Fatal intoxication after combined ingestion of formic acid, diphenhydramine and ethanol detected on post-mortem imaging

P.M. Flach, A.E. Steuer, D. Gascho, M.J. Thali, F. Berger
University of Zurich, Zurich, Switzerland

In the present paper, the authors present a case of fatal intoxication in a 25-year-old woman who committed suicide by orally ingesting formic acid, diphenhydramine and ethanol. Prior to an autopsy examination, post-mortem computed tomography (PMCT) and post-mortem magnetic resonance (PMMR) tomography were performed and revealed severe damages of the stomach, the left thoracic wall as well as parts of the liver. Imaging detected acid-induced fluid-fluid level within the thoracic cavity (fat-equivalent fluid and necrotic pleural effusion). This case report illustrates that post-mortem cross-sectional imaging may facilitate dissection of severely damaged or complex regions and may provide additional information than autopsy and toxicological examinations alone.

P.007

Queer the pitch: how to detect internal drug couriers - from customs through hospitals to forensics

P.M. Flach, S. Stamou, D. Gascho, M.J. Thali, G. Ampanozi, T.D. Ruder, W. Schweitzer, P. Laberke, L.C. Ebert
University of Zurich, Zurich, Switzerland

In recent years the methods of drug traffickers have changed and illicit internal drug concealment in so-called 'drug mules' has become more clever and more sophisticated. In Europe the current trend is to introduce drugs to the market either directly or through transit countries (mainly Africa). According to the EMCDDA, Europol (2009) and the European consumption estimates there are four main drug types: 1. cocaine (most commonly couriered drug), followed by 2. heroin, 3. cannabis and 4. amphetamine-type stimulants (ATS). Human couriers continue to be a popular method of drug smuggling and pose a medico-legal problem and radiological challenge in customs, emergency departments and even morgues.

Hence, imaging is used as a first line investigation by customs, in the ER and even in some forensic pathology institutes to detect internal drug containers. Radiological knowledge on interpretation of those cases is not widespread and may lead to erroneous reporting with even fatal consequences, e.g. in South East Asia. Therefore, this presentation based on pictorial material should summarize the pearls of radiological detection of internal drugs from customs through hospitals to forensics and queer the pitch of drug couriers and cartels.

P.008

The gas bubble sign as indicator for strangulation on postmortem computed tomography

P.M. Flach, K. Schulze, D. Gascho, L.C. Ebert, M.J. Thali, S. Stamou
University of Zurich, Zurich, Switzerland

Forensic postmortem imaging is increasing in forensic centers worldwide. Postmortem imaging is predominantly performed by postmortem computed tomography (PMCT) due to its wider availability and the possibility to visualize foreign bodies, fractures, gas embolism and hemorrhage to a certain extent precisely. Imaging of the neck is a double-edged knife. PMCT is superior to postmortem magnetic resonance (PMMR) in depicting fractures of the larynx. However, the investigator has to be trained in reading the images of the larynx, to apply the correct PMCT protocol and should be aware of the multitude of anatomical variances. PMMR on the other hand aids tremendously in diagnosing the surrounding soft tissue structures of the larynx - especially in surviving victims.

This presentation yields for diagnostic clues on detecting trauma - especially in strangulation - against the neck and its laryngeal structures on postmortem computed tomography (PMCT). Solitary gas bubble within the soft tissue in not decomposed or poly-traumatic bodies is a sign for trauma against the neck - underlined by pictorial material of forensic cases. The gas bubble sign is a diagnostic clue in cases with strangulation and may aid for image reporting of the difficult to assess anatomy of the larynx on PMCT.

P.009

Abnormalities found on postmortem computed tomography after a suicidal death due to helium inhalation - a new look on the mechanism of death?

A.B.S. Borowska-Solonynko, A.D. Dabkowska
Medical University of Warsaw, Warsaw, Poland

Background: Helium poisoning is considered to be one of the simplest and painless suicide methods. The cause of death is typically determined based on the circumstances found at the scene. Detection of helium in toxicology tests requires special procedures. In light of the lack of visible abnormalities in a conventional postmortem examination and the fact that helium is an inert gas, the presumed mechanism of death in people inhaling helium in a confined space is hypoxia due to oxygen displacement.

Objective: The purpose of this paper was to present the abnormalities visualized via postmortem computed tomography (PMCT) in a young man found dead with a helium-filled plastic bag over his head - in view of assessing the potential mechanism of death.

Case report: A body of an approximately 30-year-old male was found in a hotel room with a plastic bag filled with helium placed over his head and taped closed around his neck. There was no evidence of theft or robbery in the room and a suicide note was found. The day after he was pronounced dead, a non-contrast PMCT scan was conducted at the Department of Forensic Medicine of Medical University of Warsaw. On the day of the PMCT scan, external inspection of the body took place and revealed preserved rigor mortis and no evidence of external decomposition. The PMCT revealed the presence of a very large amount of accumulated gas in all examined areas of the body. Gas was present in veins and arteries of the head, torso, and lower extremities, as well as in the heart chambers, and between muscle fibers. Moreover, trace intracranial pneumatocele, trace pneumothorax, and trace pneumoperitoneum were found. A conventional postmortem examination was conducted three days later. The examination confirmed the presence of gas within heart chambers. Apart from that, the postmortem examination revealed internal organ congestion, pulmonary edema, subepicardial ecchymoses, and the myocardium poorly supplied with blood.

Discussion: The postmortem CT images and a lack of visible decomposition indicated massive gas embolism. These findings suggested gas embolism as the cause of death. This is consistent with literature reports of cerebral and coronary artery gas embolism in individuals inhaling helium from a pressurized canister. Although death in those instances has been explained as due to excessive pressure of the inhaled gas, other studies, including those in animals, demonstrated a number of complications following helium inhalation, including pneumothorax and mediastinal pneumatocele. Moreover, unlike other gases (such as CO₂), helium administered into blood vessels has been reported to remain there, with disastrous consequences in study animals. The same studies emphasized the characteristics of helium that could predispose it to cause the reported cases of embolism. These included: small molecular size facilitating diffusion, high viscosity, and low solubility in blood. Obviously, such radical conclusions cannot be drawn based on a single case. However, the findings provoke consideration and further data collection in order to answer the question whether the mechanism of death has not been mistakenly established due to the limitations of conventional postmortem examinations.

P.010

Post-mortem imaging in France: what is the situation in 2015? (assessment of activity and current situation)

E.D. Dumoussat¹, F.M. Macri², D.B.S. Ben Salem³, G.G. Gorincour⁴, V.S. Souffron⁵, F.D. Dedouit⁶

¹*Chu Gabriel Montpied, Clermont Ferrand, France*, ²*Chu Caremeau, Nimes, France*, ³*Chu La Cavale Blanche, Brest, France*, ⁴*Chu La Timone, Marseille, France*, ⁵*Sorbonne, Paris, France*, ⁶*Chu Rangueil, Toulouse, France*

Since October 2014, a new working group has been created within the S.F.R (Société Française de Radiologie) entitled G.R.A.V.I.T ('Groupe de Recherche en Autopsie Virtuelle et Imagerie Thanatologique') in charge of Virtual Autopsy and Postmortem Imaging. Immediately after its creation, this group organised a survey on the practice of thanatologic imaging in France to describe this activity and to share our experiences. This survey was based on a questionnaire which aimed in precisizing the place of postmortem imaging in the field of 'legal medicine' (between the external examination of the body and the forensic autopsy). The medical indications start to be well established today. The advantages and the scientific contribution of the pre-autopsic CT are doubtless today. Some french teams have up to 10 years' experience but subsides a heterogeneity within the different French groups-taking. In account local specificities (hospital architecture) these disparities can be overcome by implementing (rigorous protocols). Furthermore the financing and the valorization of postmortem imaging is variable and depend local agreements between the legal instances and the hospital. Collaboration between radiologist and forensic medicine is mandatory. The implication of radiology technicians is also crucial. Efforts are made in the formation (both nationally and internationally) of radiologists and technicians, however the standardisation of the practices and the accessibility to forensic imaging remain the main challenge in France.

P.011

An attempt of dental identification method of the relocated tooth on PMCT images

H.F. Fujimoto¹, M.I. Iino²

¹*Fujimoto Clinic for Oral and Maxillofacial Surgery, Kyoto, Japan*. ²*Tottori University Faculty of Medicine, Yonago, Japan*

Aims: We have performed more than 90 cases of dental identification using postmortem CT (PMCT) since 2011. We sometimes find the cases in which teeth are not in the original spots. In these cases we are not able to identify the victim by imaging technique comparing antemortem (AM) and PM images.

Our aim in this study is to determine if we could identify the victim who has relocated tooth on PMCT.

Case summary:

Case1

Five human teeth were found on the ground in a mountain area after a murder case in which offender had destroyed the victim on the face to anonymize.

Case2

Two teeth were found in the oral cavity and three teeth were found in the esophagus in the PMCT images of the unidentified body in another murder case. The offender had struck several severe blows on the victim's head and face using a blunt instrument.

In both cases, we were able to obtain AM panoramic X-ray images of the victims.

Methods: We scanned the 5 teeth [Case 1] and whole body [Case 2] by multi-slice CT scanner (Toshiba Medical Systems, Japan). The thickness of the slices was 0.5 mm. In the Case 2, we manually extracted and reconstructed the images of the relocated teeth using slab MIP and MASK functions on the software (Aquarius NET, TeraRecon, Foster City, CA, USA). We put the teeth back in the original spots/planes by rotating and transferring the PM images. We had to refer the AM dental panoramic X-ray images to complete this stage. We attempted to overlap the missing teeth over the AM dental panoramic X-ray image to identify the victims.

Results: The overlapped structure of the teeth could be matched the corresponding teeth on each AM dental panoramic X-ray image.

Discussion: In forensic cases, we often encounter tooth relocating to somewhere inside/outside the body on PMCT images. We have to pick up every tooth since one single tooth can be valuable information for victim identification. The tooth may indicate personal characteristics i.e. the shapes of pulp, root and so on. The present method is a revolutionary technique in dental identification though there was an issue in overlapping 3D images over 2D images. Although there can be some distortion on those images, we think the size of the distortion is negligible since the tooth is small. This method will make additional contribution to dental identification for the destructed body.

P.012

Postmortem computed tomography-angiography (PMCTA) in decomposed bodies

S.F. Franckenberg¹, P.F. Flach², D.G. Gascho³, M.T. Thal², S.R. Ross²

¹University Hospital of Zurich, Zurich, Switzerland, ²University of Zurich, Zurich, Switzerland, ³Institute of Forensic Medicine, University of Zurich, Zurich, Switzerland

(this study has been previously published online Dez 2015 in JOFRI)

Objective:

Postmortem computed tomography angiography (PCTA) is so far only used on recently deceased bodies. No study has yet been published evaluating the potential of PMCTA in decomposed bodies. The aim of our study was (1) to evaluate the general feasibility of a dPMCTA and (2) to describe artefacts known from PMCTA in general and seen in dPMCTA in particular and (3) to compare the use of different contrast agents.

Materials / Subjects and methods: 10 decomposed bodies were included independent of the assumed cause / manner of death or medical history. Computed Tomography was performed with a dual-source CT scanner. For angiography we used a lipophilic contrast medium and a hydrophilic mixture. Image interpretation was performed by a general radiologist and a board-certified forensic pathologist.

Results: We found extravasation 'hotspots' intracerebrally, around pancreas and spleen due to decomposition. Complete filling of the cerebral vessels was never achieved. Contrary to this, coronaries were completely contrasted in 6 of 10 cases. We found enhancement of stomach / intestine mucosa as well as enhancement of kidney, pancreas and spleen parenchyma in most of the cases as a postmortem artefact. We saw no difference between the two different contrast agents.

Conclusions: Large vascular structures of the torso as well as coronary arteries could be illustrated convincingly with both contrast agents used. Depending on state of decomposition diagnostic value of the pmCT-data was variably influenced. PMCTA in decomposed bodies is a simple, comparatively low cost and yet significant method in forensic imaging, which in some cases can even replace conventional autopsy.

P.013

Post-autopsy computed tomography: role and results in firearm death by terrorist attack

S.V. Visentin¹, G. Pelletti², M.D.M. De Matteis¹, M. Montisci²

¹Legal Medicine, Padova, Italy, ²Legal Medicine, University-Hospital of Padova, Padova, Italy

Introduction: Many studies have focused on the importance of post-mortem computed tomography prior to or in substitution of standard forensic autopsies, but in some particular cases a CT scan could be performed only after performing autopsy. A case of *post-autopsy computed tomography* (PA-CT) of a young Italian girl who died in a terrorist attack in a foreign country is presented.

Case Report: In the present case (probably because of the high number of victims) no information about the cause and dynamics of death was available at repatriation of the corpse and the public funeral was scheduled for the following day. In this particular context (absence of any autopsy report and no communication regarding radiological exams performed), and given the public need for clarity about the dynamic of death, a forensic examination of the corpse was requested by the Public Prosecutor in order to obtain information and to avoid any subsequent exhumation. External examination revealed an entrance wound on the apex of the nose and the left part of the upper lip and an exit wound on the posterior left thorax, under the scapula. Multiple ecchymosis and excoriations and large autopsy sutures were present in the left mandibular and cervical region and in the left supraclavicular region. The axis passing through the entrance and exit wound, as well as the characteristics of the skin surrounding the aforementioned sutures, suggested the presence of another exit wound on the left side of the neck and another entrance wound on the left supraclavicular region. In order to obtain more information about the number of entrance and exit wounds and bullet tracks, a total body PA-CT was performed. The findings obtained by the PA-CT scan provided further evidence in favour of the hypothesis of one other entrance and one other exit wound hidden by sutures, due to a single bullet track, although it was not possible to exclude with certainty an alteration during the autopsy performed previously.

Conclusions: In case of firearm death and a subsequent autopsy performed in a foreign country (i.e. victims of terrorist attacks and massacres), without immediate availability of the autopsy report, the post-autopsy external

examination could be severely limited by the presence of autopsy sutures, which prevent the recognition of the typical features of the injuries. In these cases, since PM-CT is not routinely performed in many countries, the PA-CT could be a tool for carrying out more complete investigations. Given that the value of information derived from post-autopsy forensic examination may be strongly influenced by the autopsy performed previously, in order to process the definitive considerations it is necessary to compare the data obtained by the PA-CT with the autopsy results.

P.014

Very economical immersion pump feasibility for postmortem CT angiography

W. Schweitzer¹, M. Flach¹, J. Thali², D. Gascho²

¹Zurich Institute of Forensic Medicine, Zurich, Switzerland

We compared the results of a cheap immersion pump and a heart lung machine for post mortem CT angiography. The immersion pump cost around 20 CHF when the test was done, in the meantime it can be bought for some 16 CHF. Arterial vascular filling was compared in two cases, one examined with the immersion pump, the other with a heart lung machine. No relevant differences were noted. This shows that extremely affordable equipment can be used to perform PMCTA with good vascular filling.

P.015

Foramen sternale with an osseous sternal knife stab injury

W. Schweitzer¹, S. Stamou¹, G. Ampanozi¹, J. Thali², D. Fröhlich Knaute¹

¹Zurich Institute of Forensic Medicine, Zurich, Switzerland

In a case of stabbing, a male victim suffered over 20 sharp force injuries. One of these appeared to have penetrated the sternum, but as it turned out, there was a foramen sternale whose ventrocaudal rim had suffered sharp force trauma. The findings are presented on a poster.

P.016

Visualization of computed tomography data using cinematic rendering

L.C. Ebert, D. Gascho, W. Schweitzer, P.M. Flach, T.D. Ruder, M.J. Thali, S. Stamou, G. Ampanozi

University of Zurich, Zurich, Switzerland

In forensic medicine more than in other medical specialties, relevant findings require visualization. Relevant findings may pertain to reconstructive questions, or to injuries, to organ changes in relation to the cause of death, or to risk classifications.

The results of forensic investigations are usually used as a basis for argumentation with medical lay persons, such as district attorneys, defense lawyers, judges or policemen. Inevitably, the correct understanding of the provided results is important for jurisdiction.

During the last years significant progress has been made in the field of postmortem radiology, and especially postmortem computed tomography (PMCT). Gradually more and more forensic institutes worldwide have implemented PMCT into their routine work.

Conventional Volume Rendering Techniques (VRT) are commonly used to create such visualizations of volume data. With their relatively simple lighting models, they have limitations, such as the quality of the 3D perception. A new generation of renderers that simulates the physical behavior of photons may help to overcome some of these issues by generating more photorealistic 3D reconstructions of PMCT data.

We demonstrate the capabilities and shortcomings of such a renderer (Cinematic Rendering, syngo.via Frontier, Siemens Healthcare, Erlangen, Germany) by comparing visualizations of selected cases.

P.017

Radiologic identification with standardized single CT image of the skull

T.D. Ruder, C. Brun, M.J. Thali, G. Ampanozi

Zurich Institute of Forensic Medicine, Zurich, Switzerland

The introduction of CT to forensic medicine has allowed for new ways of radiologic identification. Cross-sectional images of the paranasal sinus have proved to be a very reliable and efficient method for comparative identification for both single identifications and disaster victim identifications (DVI). To establish the identity of a single individual, ante mortem CT of the paranasal sinuses are compared to corresponding postmortem CT (PMCT) images. To achieve this, PMCT images are reformatted using MPR and individual axial images are manually adjusted to match the original axial ante mortem CT images. Although this method creates convincing results, the quality of the reconstructed images and the degree of matching details between ante mortem and postmortem images depends on the skills and technical experience of the user. Today, there is no standard operating procedure and there is no standardized imaging plane which is used for comparison.

In the experience of these authors, it usually takes several minutes to achieve a perfect match between PMCT and ante mortem images using this manual matching technique. While this approach may be adequate in single identifications the procedure is insufficient for mass disasters with multiple victims.

Here we present a simple standardized approach using one single axial plane of the skull, which is oriented along the orbito-meatal plane. To achieve this, CT images are reconstructed in MPR using anatomical landmarks of the

inner ear and the orbit. In the experience of the authors it takes less than a minute to create this standardized single image per case. One main advantage of this standardized image is that PMCT images and ante mortem CT images can be reconstructed independently of one another. This means that in mass disasters, the DVI teams in charge of ante mortem and postmortem data can also operate independently of one another and reformat their data prospectively and separately. In addition, the fact that the standardized imaging plane is parallel to the orbito-meatal plane means that the method is also readily applicable to older clinical CT data where slab thickness is typically at 5 mm, since head CT have traditionally always been acquired with the gantry tilted according to the orbito-meatal plane.

Here we describe the methodology of image reformation to obtain the standardized image plane and illustrate the outcome in selected cases.

P.018

Multi-reader assessment of rib fracture detection with a new visualization tool

S. Mauf¹, U. Held², D. Gascho¹, R. Baumeister¹, W. Schweitzer¹, P.M. Flach¹, T.D.L. Nguyen-Kim³, T.D. Ruder¹, M.J. Thali¹, T. Jentsch⁴

¹Zurich Institute of Forensic Medicine, Zurich, Switzerland, ²University of Zurich, Zurich, Switzerland, ³University Hospital Zurich, Zurich, Switzerland, ⁴Balgrist University Hospital, University of Zurich, Zurich, Switzerland

Background: Accurate assessment of rib fractures is known to be challenging. Over the past years, several methods to better visualize the chest have been developed, including curved planar reformation (CPR). CPR is a visualization algorithm which virtually unfolds the ribs on top of standard axial, coronal and sagittal multi-planar reformation (MPR). This flat-chest image allows readers to assess fracture patterns of the ribs at a glance.

Objective: The aim of this study was to compare diagnostic accuracy of raters with different professional backgrounds and varying degree of experience regarding rib fracture analysis using MPR alone and MPR plus CPR.

Method: Eight blinded readers (two radiologists (RX), two trauma surgeons (TS), two forensic pathologists (FP) and two medical laymen (ML)) separately and independently evaluated 12 post-mortem computed tomography (PMCT) data sets for rib fractures after an initial period of standardized training to familiarize raters with both viewing software tools. Sensitivity of detected rib fractures as well as false positive rates were calculated for MPR and CPR including MPR. In addition, read-out times were documented to assess for significant differences between the two reading methods.

Results: In total, there were 138 rib-fractures (127 acute and 11 consolidated). Sensitivity of detected rib fractures was 77% for RX, 62% for TS, 57% for FP, and 22% for ML with MPR and 64% for RX, 71% for TS, 54% for FP, and 34% for ML with CPR including MPR. Neither false positive rates nor read-out times differed significantly between methods. Mean false positive rates were 11%(10.6) for RX, 7%(7.25) for TS, 7% for FP (7.2), and 6%(6.3) for ML. Read-out times ranged from 5-10 min with MPR and from 4-8 min with CPR including MPR.

Conclusions: In this study, the addition of CPR to standard MPR viewing software proved to increase the diagnostic accuracy of all non-radiologists, whereas radiologists reached higher detection rates with MPR alone. These results indicate that raters with limited radiologic experience benefit from new visualization tools such as CPR, whereas than radiologists, who are accustomed to working with standard MPR, seem to be distracted by new software tools which interfere with their usual work-flow.

P.019

Post-mortem computed tomography angiography and forensic necropsy of a brown howler monkey: case report

A.C. Pinto¹, M.R.R.M. Massad², L.M.R. Ribas², C.O.B. Baron³, T.M.T. Tremor², S.T.J.R. Reis², N.S.R. Rocha²

¹FMVZ-USP, São Paulo, Brazil, ²FMVZ-UNESP, Botucatu, Brazil

Post-mortem computed tomography (PMCT) scanning with angiography (PMCTA) is a very important tool in forensic medicine helping to identify small fractures, small amounts of gas collection and to predict the cause of death in trauma cases. Although it has been increasing significantly in human forensic medicine in the last few years, there are still little studies of post-mortem images in animals. The purpose of this case report was to document a well-succeeded PMCTA study in a brown howler monkey (*Alouatta guariba clamitans*) and to compare this technique to forensic necropsy. An ill free-living male howler monkey was found and rescued in the city of São Paulo, Brazil. It was in a poor body score condition, had some missing tooth, had a deep injure in the left hind limb with myiases and was estimated as an old animal. Because the poor prognosis the animal was sacrificed and sent to perform PMCTA and forensic necropsy. Images were acquired in the transverse plane, with the body placed in dorsal decubitus, on a 16-slice multidetector scanner. The scan parameters were 120 kVp, 350 mAs, the slice thickness ranged from 1-2 mm and the interval ranged from 0,5-1 mm. A mixture solution of an ionized water-soluble contrast medium (iohexol, at 300 mg/mL) and polyethylene glycol 300 (ratio of 1:20) was prepared in a total volume of 98 mL. The femoral artery and vein were cannulated and connected to an injection pump and half of the mixture was perfused in each phase. Some image findings were not seen at the forensic necropsy, as thyroid cartilage fracture associated with mild soft tissue swelling and the presence of gas in the brain and in the abdominal cavity. This was the first PMCTA performed in a howler monkey and it gave valuable additional information to conclude the possible cause of the disability of the animal. In conclusion, post-mortem images are a very important tool for forensic necropsy being part of the future of modern pathology.

Financial support: Capes

P.020

Complete cardiac and bronchial avulsion in a dog: post-mortem computed tomography and forensic

necropsy analysis

A.C. Pinto¹, M.R.R.M. Massad², L.M.R. Ribas², C.O.B. Baroni³, T.M.T. Tremor², S.T.J.R. Reis², N.S.R. Rocha²
¹FMVZ-USP, São Paulo, Brazil, ²FMVZ-UNESP, Brazil

Cardiac and bronchial avulsion are a very rare condition in animals and humans and are mainly related to blunt chest trauma. Post-mortem computed tomography (PMCT) has a high sensitivity for identifying trauma injuries, being an important additional technique to forensic science. The aim of this case report was to describe non-contrasted tomographic findings of a cardio-vascular trauma followed by a forensic necropsy in a dog. A female dog was struck by a vehicle, had sudden death and was sent to a veterinary hospital. PMCT images were acquired on a 16-slice multi-detector scanner and the forensic necropsy was performed afterwards. Thoracic images revealed aorta avulsion, heart dislocation, a complete right bronchial rupture, pneumothorax, pleural effusion, subcutaneous emphysema, several rib and spine processes fractures and diaphragmatic rupture. Abdominal images showed free abdominal fluid, laceration of the abdominal muscles with eventration of small bowel. Forensic necropsy findings corroborated the hypothesis of the cardiac and bronchial avulsion. Although there was no contrast media administered in this case, it was possible to establish the cause of death only with the PMCT. In conclusion, computed tomography proved to be an important diagnostic technique in forensic veterinary medicine.

Financial support: Capes

P.022

Effect of repeated freeze-thaw cycles on human musculoskeletal tissue visualized by post-mortem computed tomography (PMCT)

A.C. Klop, K.L. Colman, M.E.M. Vester, R.R. van Rijn, R.J. Oostra
Academic Medical Center, Amsterdam, Netherlands

Background: Human bodies donated to hospitals and other institutes for research and instruction purposes are occasionally preserved using a fresh-frozen conservation method. This method entails the material being frozen and stored immediately upon arrival. However, the material is frequently thawed and refrozen multiple times in order to efficiently make use of the donated bodies in multiple instruction sessions. Previous research on human allograft tissue has shown that repetitive freeze-thaw cycles significantly impair the integrity of the respective tissue. To date, no research has been conducted on the integrity of human cadaveric material used for instruction purposes following repetitive freeze-thawing.

Objective: In this study we employed a novel approach in order to ascertain if potential effects of freeze-thawing can be visualized using post-mortem computed tomography (PMCT) technology. Moreover, two different ambient thawing temperatures (2°C/19°C) were tested to determine if a preferable thawing temperature exists.

Materials and methods: Five pairs (n=10) of detached human cadaver upper extremities, which had been stored at the freezing facilities of the Academic Medical Center (AMC) at -20°C for an average period of 2.9 years were used for this study. Total body PMCT scans (Siemens Sensation 64, Siemens, Erlangen, Germany) made upon arrival were used as reference measurements (t_0) in the consecutive analysis. The extremities were divided into two sample groups. Samples in group A (n=5) were thawed for 48h at an ambient temperature of 2°C. Samples in group B (n=5) were thawed for 24h at an ambient temperature of 19°C. After thawing, CT scans were performed (t_1) (Philips Brilliance 64, Philips Healthcare, Best, the Netherlands) on all samples, and subsequently the samples were re-frozen at -20°C. The freeze-thaw cycle described above was repeated a further three times (t_2 , t_3 , t_4). For each sample per time period (t_0 - t_4), CT attenuation was measured in Hounsfield units (HU) with a region of interest (ROI) in *M. brachioradialis*, *M. flexor carpi ulnaris* and *M. extensor digitorum*. Intra-group comparisons of HU values obtained for group A (t_0 - t_4) and group B (t_0 - t_4) will be performed. Furthermore, each data point obtained from group A will be compared to that obtained from group B.

Results: This study is part of a research project which is currently being conducted at the Academic Medical Center. Whether the effects of multiple freeze-thaw cycles and different thawing temperatures have a significant effect on the integrity of human musculoskeletal structures and if this effect can be visualized on PMCT images will be presented at the congress of the ISFRI 2016.

P.023

Sequences and technique for postmortem magnetic resonance imaging in children

N. Jawad, W. Norman, R. Jones, M. Taylor, J. Arthurs
Great Ormond Street Hospital, London, United Kingdom

Postmortem magnetic resonance (PMMR) imaging is becoming more widely used following perinatal and paediatric deaths. Accurate and detailed imaging is vital to minimise interpretation errors, and there are many different sequences and imaging parameters described in the literature.

This abstract will provide the following:

- A literature search of the last 20 years of perinatal PMMR with comprehensive analysis of the protocols and sequences used.
- An overview of our current protocols for PMMR imaging at 1.5T, with guidance regarding sequences and imaging parameters so that the reader can understand the logic behind each acquisition step, to serve as a useful day-to-day reference guide to performing PMMR.
- Examples of optimised brain and body imaging using our protocol, including diffusion-weighted and susceptibility-weighted imaging.

- Examples of normal and abnormal findings using our protocol.

We will cover the principles behind optimal coil selection, imaging time constraints, and age-adaptation of protocols. We cover the use of isotropic 3D instead of 2D images for ease of multiplanar reconstruction, and limitations of 1.5T PMMR. We discuss brain, spine and body imaging, with particular reference to high resolution body imaging. By presenting our standardized departmental protocol for PMMR imaging, we hope that it will serve as a useful day-to-day reference guide, for those looking to establish a similar service in their institution. It may also form a basis for a common protocol for future collaborative studies.

P.024

Postmortem CT versus forensic autopsy: frequent discrepancies of tracheobronchial content findings

L.P. Lombardo¹, Z.W.D. Zech², C.J. Jackowski², N.S. Schwendener², E.B. Brencicova², S.F. Schuster²

¹*Inselspital, Bern, Switzerland*

ARTICLE PUBLISHED: 2015 INT J LEGAL MED

In their daily forensic casework, the authors experienced discrepancies of tracheobronchial content findings between postmortem computed tomography (PMCT) and autopsy to an extent previously unnoticed in the literature. The goal of this study was to evaluate such discrepancies in routine forensic cases. A total of 327 cases that underwent PMCT prior to routine forensic autopsy were retrospectively evaluated for tracheal and bronchial contents according to PMCT and autopsy findings. Hounsfield unit (HU) values of tracheobronchial contents, causes of death, and presence of pulmonary edema were assessed in mismatching and matching cases. Comparing contents in PMCT and autopsy in each of the separately evaluated compartments of the respiratory tract low positive predictive values were assessed (trachea, 38.2 %; main bronchi, 40 %; peripheral bronchi, 69.1 %) indicating high discrepancy rates. The majority of tracheobronchial contents were viscous stomach contents in matching cases and low radiodensity materials (i.e., HU < 30) in mismatching cases. The majority of causes of death were cardiac related in the matching cases and skull/brain trauma in the mismatching cases. In mismatching cases, frequency of pulmonary edema was significantly higher than in matching cases. It can be concluded that discrepancies in tracheobronchial contents observed between PMCT and routine forensic autopsy occur in a considerable number of cases. Discrepancies may be explained by the runoff of contents via nose and mouth during external examination and the flow back of tracheal and main bronchial contents into the lungs caused by upright movement of the respiratory tract at autopsy.

P.025

PMCTA: effects of contrast media on atherosclerotic plaques in an animal model

M.K. Chainchel Singh¹, R.A.J. Awang Jalil², N.M.N. Mohd Noor³, N.K.M.K. Mohd Kornain², H.M.N. Nawawi²

¹*Universiti Teknologi Mara (UiTM), Selangor, Malaysia*

²*Faculty of Medicine, Universiti Teknologi MARA, Sungai Buloh, Selangor, Malaysia,* ³*Faculty of Medicine Universiti Teknologi Mara (UiTM), Selangor, Malaysia*

Background: Coronary artery disease (CAD) due to atherosclerosis triggered by local arterial occlusion with thrombus overlying a pre-existing atherosclerotic plaque is a known cause of major cardiovascular events. Thus, imaging technologies involving optical coherence tomography, computed tomography (CT), Computed Tomography Angiography (CTA) and high-resolution MRI have been developed as markers of coronary atherosclerosis in order to identify these atherosclerotic plaques. Yet, the effect if any of the contrast media used in CTA on the histopathology of atherosclerotic plaques have not been widely explored more so in post-mortem cases.

Objectives: This study aims to determine and study the effect of water base contrast media used in Post Mortem Computed Tomography Angiography (PMCTA) on the histopathology of atherosclerotic plaques in rabbits.

Methods: The study was performed on 20 male New Zealand white rabbits. These rabbits were divided equally into 2 groups i.e 10 rabbits as control group while another 10 rabbits were given a high cholesterol diet (HCD) for 12 weeks. Five rabbits from each group were then given intravenous contrast media before being sacrificed. All rabbits were sacrificed and the entire length of aorta dissected and submitted for histopathological examination.

Results: Histopathological examination of the atherosclerotic plaques showed no significant effect of contrast media in both groups of rabbits i.e with or without intravenous contrast media injection.

Conclusion: The contrast media used in PMCTA does not affect the histopathology of atherosclerotic plaques.

P.026

Towards “virtual” forensic anthropology: the accuracy of 3D skeletal reconstructions from full body CT-scans

P. Bor¹, K. Colman¹, J.G.G. Dobbe², K. Stull³, G. Streekstra², R.J. Oostra¹, R.R. van Rijn⁴, H.H. de Boer⁵, A.E. van der Merwe¹

¹ *Department of Anatomy, Embryology and Physiology, Academic Medical Center, Amsterdam, The Netherlands,*

² *Department of Biomedical Engineering and Physics, Academic Medical Center, Amsterdam, The Netherlands,*

³ *Department of Anthropology, Idaho State University, Pocatello, USA,*

⁴ *Department of Radiology, Academic Medical Center, Amsterdam, The Netherlands,*

⁵ *Department of Pathology, Academic Medical Center, Amsterdam, The Netherlands*

Background: Forensic anthropologists play an important role in the identification of unknown dead persons. To do so, they compile a biological profile of unknown victims based on morphological and metric characteristics of the skeleton. These characteristics differ between generations and populations. Forensic anthropological casework has experienced a reduction in reliability because there isn't a large enough modern skeletal collection available in the

Netherlands to use as a reference population to develop reliable methods. A possible alternative is the use of a virtual skeletal database that is based off of patient derived CT scans. Such a database would not only provide up to date information on the Dutch population, but could also be used for further development of forensic anthropological methods. However, before virtual skeletal databases can replace actual skeletal collections, the accuracy of how well 3D virtual bones resemble dry bones needs to be determined.

Objective: To determine to what extent a virtual skeletal element represents the dry bone counterpart.

Materials and Methods: For this study, five pelvises (n=5) were scanned using a Siemens Sensation 64 CT scanner (Siemens, Erlangen, Germany) (Post Mortem Anatomy Protocol: 120kV, 325mAs, slice thickness 0.75mm, increment 0.4mm). The program Articul8 was used to produce virtual skeletal elements (segmentations) out of these CT scans. Once scanned, the pelvises were macerated for the dry bone measurements.

Two observers, measured a set of landmarks on both the virtual and dry bone pelvises. Both observers performed each measurement twice. The difference between the measurements between the virtual and dry pelvises were compared, with acceptable levels of error set at ± 1 mm and ± 2 mm. TEM and %TEM were calculated to evaluate the intra- and inter-observer error variation in both the dry bones and the virtual bones, and to compare the dry bones to the virtual bones. Acceptable levels for TEM and %TEM are 1mm and 2,0% respectively.

Percentage agreement was calculated to establish how reliable the method used for comparing dry bones and bone segmentations is. A percentage agreement of 75% or higher was considered acceptable.

Results and Discussion: The results of this study, determining whether virtual bone segmentations accurately represent dry bones or not, will be presented at the conference.

P.027

Post mortem computed tomography angiogram (PMCTA) in vascular related death: just a pretty picture or really worth a thousand words?

S.N. Abdul Rashid

Faculty of Medicine & Health Sciences, Universiti Putra Malaysia, Serdang, Selangor, Malaysia

Introduction: PMCTA is a recently introduced technique to compliment Post Mortem Computed Tomography (PMCT) due to its limitation in organ and vascular opacification. Studies on the role of PMCT and PMCTA as adjunct to autopsy have shown promising results. However from the medicolegal aspect is PMCTA findings and images adequate and optimal for diagnosing cause of death related to vascular injury and thus can be used as evidence in the court of law? We present case studies on the role of PMCTA in diagnosing and assisting forensic pathologists in the cause of vascular related death in Hospital Kuala Lumpur (HKL)

Case 1 of 3 cases

History: A 35-year-old, female pillion rider was involved in road traffic accident. She suffered injuries to the left pelvis and thigh and was diagnosed of possible vascular injury. Emergency laparotomy was performed with no significant intra-operative abnormality noted. Intra-op abdominal and bilateral lower limb angiograms were negative. She died 7 hours later. The body was transferred to the mortuary for autopsy in establishing the cause of death.

PMCTA findings: PMCT showed a very large subcutaneous collection in the left pelvis and thigh. No fracture or dislocation noted. PMCTA showed extravasation of contrast media into the collection at the level of the mid-thigh coming from the transected left femoral vein. There were also foci of extravasation of contrast media in the other parts of the collection indicating vascular injury.

Autopsy findings: Autopsy was done and confirmed the finding of circumferential cavity between the subcutaneous layers and the muscles layer of the left pelvic and thigh region with transected left femoral vein. Cause of death was hypovolemic shock secondary to massive bleeding secondary to road traffic accident. A final diagnosis of a rare case of lethal large *morel-lavallée* with vascular injury was established.

Conclusion: These Case Studies have demonstrated the role of PMCTA as a very important adjunct to conventional autopsy in vascular related death. The forensic pathologists are able to focus and alter their autopsy based on the PMCTA findings. We have demonstrated that PMCTA findings and images are adequate and optimal for diagnosing cause of death related to vascular injury and thus can be used as evidence in the court of law. It is not just a pretty picture but really worth a thousand words.....

P.028

The value of postmortem computed tomography in burned victims in a forensic setting

H.M. de Bakker¹, G.H.J. Roelandt², V. Soerdjbalie-Maikoe³, R.R. van Rijn², B.S. de Bakker²

¹Groene Hart Ziekenhuis, Gouda, Netherlands, ²Academisch Medisch Centrum, Amsterdam, Netherlands,

³Nederlands Forensisch Instituut, Den Haag, Netherlands

Objective: To demonstrate the additional value and remark the limitations of postmortem computed tomography (PMCT) to forensic autopsies of burned victims.

Method: On 51 burned victims who were presented for a forensic autopsy in the Netherlands Forensic Institute (NFI) in the past 10 years, pre-autopsy post-mortem computed tomography (PMCT) was performed, followed by a forensic autopsy including histological and toxicological investigation. All PMCT scans were performed in the Groene Hart Hospital as they had a collaboration with the NFI and were initially assessed by one forensically experienced radiologist, who was at that time not informed of the autopsy findings. Retrospectively, PMCT and autopsy results were reviewed and the value of PMCT compared with autopsy was analyzed.

Results: Preliminary findings, gathered from 30 cases, demonstrated that the assessment of affected soft tissues, damaged skeletal structures (e.g. the facial skeleton and long bones) and presence of intracranial air is generally performed easier on PMCT compared to autopsy. Findings in soft tissues exposed to fire included subcutaneous

emphysema, retraction and loss of skin and muscle, streaking of fatty tissue and swelling and consolidations of the lungs and brain. However superficial damage to the skin was not detectable on PMCT, the radiologist was able to measure the depth and localization of thermal damage in significantly affected areas. In skeletal structures, PMCT revealed small and large fractures, fragmentations and thermal damage to the bones and enabled the radiologist to determine whether fractures were pre-existent or new. Furthermore, separation of the internal and external tables of the calvaria, air inside bones exposed by fire and localization of foreign bodies were also detected easier on PMCT than by autopsy. However, differentiation between thermal damage and other damage mechanisms like blunt force was often difficult in both PMCT and autopsy, due to the extent of damage caused by the fire.

Limitations of PMCT are that superficial changes such as skin splitting, superficial pre- or postmortem burns, smoke soiling and signs of smoke inhalation as important parameter to determine if the victim was alive and breathed during the fire, were not possible to detect by PMCT in contrast to autopsy. The cause of death was therefore only to be reliably determined by autopsy, including toxicological measurement of carboxyhemoglobin and histology.

Conclusion: For the assessment of affected skeletal structures, soft tissues and the presence of intracranial or intraskeletal air and foreign bodies, PMCT can be of significant importance in addition to the forensic autopsy in burned victims, but autopsy including toxicological investigation and histology remains the gold standard to determine the cause of death in burned victims.

P.029

The forensic holodeck - an immersive display for forensic crime scene reconstructions

L.C. Ebert¹, M. Braun², A. Leipner¹, S. Kottner¹, D. Gascho¹, W. Schweitzer¹, M.J. Thali¹

¹University of Zurich, Zurich, Switzerland, ²City Police Zurich, Zurich, Switzerland

3D forensic incident scene reconstructions incorporate a variety of three-dimensional image modalities. Traditionally, these types of reconstructions are displayed using two-dimensional means such as paper or computer screens, which comes with a loss of information that can be relevant to answer a specific forensic question. We propose a system that uses low cost, off the shelf virtual reality glasses for virtual crime scene visits based on 3D forensic reconstructions.

The system is based on a virtual reality headset originated in the gaming industry (Oculus Rift, Oculus VR, Inc., Irvine, USA). The headset offers integrated real-time head rotation tracking and a large viewing volume. To increase the freedom of movement, we added an external optical tracker for positional tracking (OptiTrack V100:R2, NaturalPoint, Inc., Corvallis, USA). The software is based on the cross-platform game engine known as Unity 3D, version 4 (Unity Technologies, San Francisco, USA). To support the optical tracker, we wrote a Dynamic Link Library (DLL) in C++ using Visual Studio 2010 (Microsoft Corp, Redmond, USA) as well as Unity scripts in C#. We demonstrate the abilities of the system on a case of a shooting incident which was reconstructed using laser scan data from the incident scene as well as surveillance camera footage.

P.031

Post-mortem changes in musculoskeletal and subcutaneous tissue in relation to post-mortem interval and cause of death on post-mortem CT

W.M. Klein¹, T. van Grisven¹, B. Kubat², S. Lafebre¹

¹Radboud university medical center, Nijmegen, Netherlands, ²Maastricht university medical center, Maastricht, The Netherlands

Objectives: Some aspects of the deceased body on post-mortem CT (PMCT) can be difficult to interpret as either distinctive signs of pathology or normal post-mortem signs of decomposition. One of these aspects is subcutaneous edema. We hypothesize that edema is a normal post-mortem sign representing livor mortis, increasing with the post-mortem interval (PMI). Further we investigate if rigor mortis is measurable on PMCT.

Methods: We investigated five bodies that were donated to science which had PMCT every hour from 4 to 48 hours post-mortem and we measured radiodensity of ventral and dorsal subcutaneous and musculoskeletal tissue. We also measured subcutaneous and musculoskeletal radiodensity in 56 cases of clinical patients (who each had 1 PMCT) and correlated to the PMI and cause of death. We compared ventral to dorsal ratios to investigate the gravitational effects in accordance with livor mortis.

Results: In the science PMCTs, we found a decrease in radiodensity of the ventral to dorsal muscle ratio in correlation to the post-mortem interval. Further results showed diversity in increasing and decreasing radiodensities of subcutaneous and musculoskeletal radiodensities. Also no correlation to the PMI could be confirmed. In the clinical PMCT scans, no relevant relation of the radiodensity to PMI or the cause of death could be confirmed.

Conclusion: Post-mortem subcutaneous and musculoskeletal PMCT radiodensity changes are common, however these seem not relevant in correlation to PMI or cause of death. Therefore, these changes seem not useful for establishing the time of death, nor do they seem to give any direction to the diagnosis of the cause of death

P.032

Autopsy Imaging (Ai)¹ - another postmortem imaging evolving in Japan

M.Y. Yoshida¹, S.Y. Yamamoto², M.I. Iino², H.T. Takano²

¹Kyorin University Graduate School of Medicine, Tokyo, Japan

It is well-known that the rates of traditional autopsies have declined worldwide. In response to this situation and thanks to the technological advancement in diagnostic imaging field, CT and MRI examinations of the deceased are increasingly being utilized for death investigation and victim identification. In Japan, the autopsy rate for unnatural

deaths is extremely low (around 2%) and the dysfunction of death investigation system has been pointed out for long time. For the purpose to complement this situation, the concept of Ai was proposed to establish an important role of postmortem imaging in death investigation system in Japan by Hidefumi Ezawa in 2000, who is known as a novelist Takeru Kaido. The concept of Ai was rapidly and sensationally introduced to the general public in Japan as an useful method in death investigation firstly by several best-selling novels written by him and the concept of Ai gradually spread into medical and non-medical professionals such as forensic pathologists, radiologists, government and other interested parties. I would like to give an overview of Ai in Japan, which has been uniquely evolving, referring to its history and current situation.